Indian Journal of History of Science, **19** (2): 118—124 (1984)

THE CONCEPT OF *YANTRA* IN THE *SAMARĀṄGAṆA-SŪTRADHĀRA* OF BHOJA*

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(Received 24 January 1983)

Natural philosophy and occult art are the two basic factors in the concept of *yantra* formulated by Bhoja in his *Samarāṅgaṇa Sūtradhāra*. The former is represented in the idea of five elements as the constituent elements of *yantras*. The latter is revealed in the treatment of the entire theory of *bīja* in the formation of *yantras* in the way resembling the alchemical notion of *bīja* for bringing out different alchemical preparations.

This philosophy of *bīja* (constituent elements) in the concept of *yantra* is the subject of discussion of the present paper.

In ancient philosophical speculations elements or the powers of nature, four or five in number were conceived as the basic factors or fundamental principles behind the origin of the material world. In Indian philosophy it is called *bhūta* (engendering something tangible), in Chinese thought it is *hsing* (force) and in Greek idea it is *rhizomata* ("roots" of things).[1] Bhoja in the *Yantrādhyāya* section (Chapter 31) of his *Samarāṅgaṇa-Sūtradhāra* describes elements as *bīja* (seeds) or "active principle" in explaining the composition of *yantras* (mechanics). The term *bīja* in the sense of 'elements' appears to have its occurrence for the first time in the *Samarāṅgaṇa-Sūtradhāra*. The Greek philosopher Anaxagoras (*c.* 500-428 B.C.) expounds elements as full of "seeds" or "live principles" giving way to new creation.[2] The impact of Greek thought in Indian concept and ideas regarding element cannot be ruled out in this respect. Likewise the term *bīja* indicating element as "creative principle" is also analogous to the alchemist's theory of *bīja* or seed or germ, causing change of one metal into another. This philosophy of *bīja* in the concept of *yantra* is the subject of discussion of the present paper.

I

The elements and the yantras

Bhoja defines *yantra*[3] as "that is a *yantra*, or machine, is one which controls the *bhūtas* and makes them serve a specific purpose." Also "the *mahābhūtas*, like the earth, the water, the fire, and the ether, though inter-dependent in their operations and movements, when brought to act in a particular way, that way is *yantra*." Thus *yantras*

*Paper presented at the Seminar on 'Scientific Works of King Bhoja', organised by the School of Studies in Sanskrit at Ujjain on the occassion of the Silver Jubilee Celebrations of Vikram University, Ujjain, March, 1-6, 1982.

(machines) are explained as penta-*bhautik* in its composition. This nature theory in the understanding of *yantra* is found predominant in the speculation over science of mechanics as fundamentally concerned with the doctrine of Nature of the Greek philosophers like, Hero of Alaxandria (*c.* 2nd century A.D.) and Vitruvius (between last part of the era, Before Christ—Christian era).[4] In India this idea of correlation between cosmic power and machine power has not hitherto been brought into notice by anybody else than Bhoja in the 11th century A.D.

Earth (*Pṛthivī*), water (*jala*), fire (*vahṃi*) and air (*marut*), the four elements with the element ether (*ākāśa*) which is the substratum of the four other elements,[5] act as the primary (*aṃśī*, i.e. which is associated with other elements) as well as the subsidiary *bījas* (*aṃśa*) or elemental factors in the innovation of *yantra*.[6] Bhoja declares that the *yantra* and its *bīja* are inseparable entity like the soul and body ("*ātmaiva bījam sarveṣām pratyekamaparāṇyapi*").[7] The *bījas* are stated as not capable of functioning independently, but in combination with the other members. All *yantras* are therefore the conglomeration of two or three or four *bījas*,[8] one principal and the others are its allies. It is to be noted here that the four elements have not alliance with each other. This is reflected in Bhoja's statement about the properties of particular *bīja* in combination with the other *bījas*.

The primary or principal *bīja* has proportion of greater degree while the others have proportion of lesser degrees. The same *bīja* may therefore be applied in so many degrees resulting in the corresponding varieties of them.[9] ("*Bhutamekamihodriktamanyadhīnam tato'dhikam | Anyadhīnataram cānyadevamprāyairvikalpitaiḥ || Nānā bhedā bhavantyeṣām kastān kārtsnena vaśyati*"). This permutation and combination in the proportions of the four elements result to the innovation of innumerable varieties in the same way as the medical authorities have analysed sixty-four *rasas*, i.e. tastes origined out of six primary *rasas*.[10] The *yantra* is named after the particular *bīja* predominant in the composition. In innumerable combinations the combined elements are either of the same traits or of opposite character ("*Bījam caturvidhamiha pravadanti yantreṣvambhognibhūmipavanairnihitairyathā | Pratyekato vahuvidha hi vibhāgataḥ syānmiśrairguṇaiḥ punaridam gaṇanāmapāsyet ||*").[11] According to Greek philosopher Hero of Alexandria various combinations are effected by the union of air, earth, fire and water and concurrence of three or four elementary principles, some of which supply the most pressing want of life, while others produce amusement and alarm.[12]

Characteristic of the bījas

Bīja in its entirety covers three essentials of a *yantra:* (1) *svabīja* or *svakīya-bīja*, basic or primary element, (2) *pārthiva-bīja*, material substances and (3) *bīja*, allies or associate elements contribute to different functionings of a *yantra*.

1. *Svabīja* or *Svakīya-bīja* (basic or primary elements):

The four elements, by virtue of their proportions in greater degrees than the

other constituent elements in the composition of *yantra*, form the four basic elements of four types of *yantras: pārthiva* (earth), *ap* (water), *vahṇi* (fire) and *marut* (air). These are called *svabīja* or *svakīya-bīja* (i.e. one's own element). Bhoja enumerates the traits of some of the primary *bījas*. Thus—

(*i*) *Pārthiva bīja* (earth element). The primary *bīja*, *pārthiva*, comprise (*a*) the materials of the body of the machine, consisting of four metals, viz., iron, copper, silver and tin, timber, hide and cloth; (*b*) different parts of the machine; and (*c*) tools.[13]

(*ii*) *Marut bīja* (air element). The physical properties of air, laid down in the text, comprise, upward rising (*ucchrāya*), superabundant volume (*ādhikya*), speedy upward movement (*atyantamūrdhvagāmitvam*) and lightness (*ayasa*). Air, by all its physical traits, is subject to make confine in air-tight container[14] ("*marut svabhāvajo gāḍhairgrahakaiśca pratīpsitaḥ*"). Air attains a corporeal body and serves the purpose of *bīja* on being seized by three appliances, bellow, fan and flaps.[15]

(*iii*) *Jala bīja* (water element). Water, the primary *bīja*, includes here the machine's own water and other water.[16]

(*iv*) *Vahṇi bīja* (fire element). Its primary *bīja* is fire, which has no allies excepting that of *pārthiva* (earth).[17]

2. *Pārthiva bīja* (material substances):

The *pārthiva bīja* or earth element is attributed with the properties of form or *rūpa* for which it acts as the base of the other elements, having no solid form ("*sādhyasya rūpa-vaśataḥ sanniveśo yato bhavet*").[18] It is inoperative (*niṣkriya*), but is the seat of operations of the other elements. This theory of earth's inoperativeness is opposite to operative trait of earth in the Nyāya-Vaiśeṣika.[19] Traces of affinity are however noticed in the Sāṅkhya view about inertness of Pṛakrti, the ultimate Ground of Creation.[20] Bhoja enumerates different *pārthiva-bījas* for the manifestation of different elements. These include:

(*i*) *Pṛthivī* (earth): Same as stated above in case of *svabīja* or basic element.[21]
(*ii*) *Marut* (air): Bellow (*dṛti*), fans (*bījana*) and flaps (*gajakarṇa*).[22]
(*iii*) *Jala:* Timber, hide and iron.[23]
(*iv*) *Vahṇi:* Four metals, viz. iron, copper, silver and tin, and clay.[24]

3. *Bīja*, i.e. the associate elements in the innovations of a *yantra:*

The four elements, in turn, become a primary *bīja* and an associate *bīja* in the composition of a *yantra*. Each element is distinguished by some specific properties in their association with a particular primary element in the composition of a *yantra*. The properties of four *bījas* in relation to four types of *yantras* may be summed up as follows. In this respect, it is to be noted that the earth being devoid of any kind of action the properties of air, water and fire are analysed here.

Marut bīja (air-element).

The principal activities of this element lie in generation and projection of some sort of movement or force to any *yantra*. These are revealed in—

(*i*) *Pārthiva yantra:* Combining the *yantra* with power or force or mobility (*pratyeṣaka*), generation of diverse motions (*janaka*), impulsion (*preraka*) and receiver (*grāhaka*) and collector (*saṃgrāhaka*) of power.[25]

(*ii*) *Jala-yantra:* Accumulation (*saṃgṛhīta*) and projection (*datta*) of power, filling the void (*pūrita*) and impelling push (*pratinodita*).[26]

(*iii*) *Vahṇi yantra:* Storage of power or force.[27]

(*iv*) *Marut yantra:* Impulsion, accumulation and generation of power.[28]

Jala bīja (water-element).

(*i*) *Marut yantra:* Four types of movements, viz. impetus, impact or striking (*abhighāta*), revolution (*vivarta*) and circumumbulation (*bhramaṇa*).[29]

(*ii*) *Pārthiva yantra:* Pouring of and filling with water (*dhārā jalabhāraśca*) and generation of a belt of water (*payaso bhramaṇam*).[30]

Vahṇi bīja (fire-element).

(*i*) *Pārthiva yantra:* Faculty of heating and exciting (*tāpa-uttejana*), and of mixing (*stobha*) and dissolving (*kṣobha*) in association with watery elements in the *yantra*.[31]

(*ii*) *Jala yantra:* Same as with *pārthiva bīja*.[32]

(*iii*) *Marut-yantra:* Accumulation of force or power by the heating and exciting functions of fire.[33]

The properties of the four elements in connection with the mechanization of *yantra*, bear no remarkable identity with the properties of the four elements propounded by the Nyāya-Vāiśeṣikas. Certain affinities are however noticed in the properties of five elements particularly of *marut* and *vahṇi* in form of *vāyu* and *pitta* conceived by the medical authorities in connection with different functions of body. Thus:

Samarāṅgaṇa-Sūtradhāra	Medical Texts	*Samarāṅgaṇa-Sūtradhāra*	Medical Texts
Marut	*Vāyu*	*Vahṇi*	*Pitta*
Different types movement of *yantra*[34]	All types of movement of body parts[35]	Faculty of heating and exciting[36]	Heating and combustion[37]

Filling the void[38]	Filling the void[39]	Accumulation of force or power in the *yantra*[40]	Contribution of energy or force to the human system[41]

Alliance and non-alliance between elements in the composition of yantras

Each element in its composition inheres the basic properties of other elements in addition to its own element in proportion of greater degree. All *yantras*, as noted above, are composed of one primary *bīja*, and one, two or three subsidiary or secondary *bījas*. These secondary or associated *bījas* are not always allied to the primary or basic *bīja* in context of some effective result. The analysis of Bhoja's idea of combination of *bījas* show the following alliance and opposition among the four elements:

Yantras	Allied *bījas*	Non-allied *bījas*
Pārthiva	Water, fire, air	× × ×
Marut	Earth, water, fire	× × ×
Jala	Earth, air, fire	× × ×
Vahṇi	Earth	Water, air, fire

It is interesting to note that fire in its state of being a primary *bīja* (element), no secondary elements are found to have been associated with it excepting the earth element. The implication behind the role of fiery element as secondary *bīja* for producing some tangible effect to the mechanization of *yantra* appears to lie in its existence in proportion of lesser degree in compound with other elements. In its greater proportion as primary *bīja* in the combination with other elements the inherent qualities reside in fiery elements are opposed to the qualities present in the other elemental body.

II

The idea of *bīja* or "seed principle" in the analysis of *yantra* bears some affinity with the alchemical notion of *bīja* in the preparation of noble metals from base metals by changing their compositions. *Bīja*, which forms an essential substance in this alchemical preparation, consists of pure gold or pure silver of some specific weight in respect of specific weight of metals to be converted into another. Gold was applied for the preparation of gold and silver for silver. Alchemical texts from *c.* 9th century A.D. onwards contain this idea of *bīja* or "seed" principle effecting regeneration.[42]

This theory of "seed" or "germ" for regeneration of a metal of a different com-

position from a molten mass of another metal has an universality in the alchemical notions in the ancient world. The pseudo-Democritan text of one Democritus, is believed to have flourished in a period between 2nd century B.C. to 5th century A.D. formulates that by reaction of suitable chemical substances in accordance with those laws of sympathy and antipathy which were believed to operate throughout the cosmos, a regeneration could be brought about, aided, as in living world, by the provision of heat and moisture and the addition at times of a small quantity of gold to reinforce the action of seed.[43]

The analysis of the concept of *bīja* in the understanding of *yantra* or machine thus gives an insight to two fundamental principles in the formulation of this concept:

(*i*) Nature theory or the theory of microcosm and macrocosm dominating the naturalistic thought in the philosophical speculations throughout the ancient world.

(*ii*) The pseudo-scientist's idea of reinforcing generation by the agency of seed or *bīja*.

In both these two observations an intermixture of Indian and Greek thoughts are woven with great care for a new light to science of mechanics in the history of Indian science.

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